

Should This Exist? Episode Transcript: Halo

DANIEL CHAO: When people first hear about what I'm doing and the technology we're designing, it's usually one of two things. One is this feeling of fear. The other one is this feeling, like "Wow, that's complete quackery. That can't work."

If it was not the moon, where can you go? You go to the brain.

Nobody's really ever asked this question: "Is this a solvable problem?"

The countless, thankless, thousands of hours of repetition to perfect a craft. We try, try, try and we don't get enough. And then we just quit.

We call it muscle memory, but we know that the memory is not in our muscles. It's in our brain.

Olympic athletes, musicians, pilots, young surgeons, fallen soldiers. Where else can we apply this thing? Learning a foreign language, learning to play the cello, help at rehab.

The one thing I would ask of the skeptic is to have an open mind

CATERINA FAKE: The scientist you just heard was Daniel Chao. He invented a headset that hacks your brain with electricity so you can learn as fast as a kid again. Right now, this headset helps you learn motor skills faster. In fact, many elite athletes are already using it during training. But we're not far from a future when Halo could help *anyone* master *anything*.

Daniel is on the Should This Exist? because he wants to guide his invention towards a future that's good for all of us.

[THEME MUSIC]

FAKE: I'm Caterina Fake, your host for Should This Exist?. I believe that the boldest new technologies can help us flourish as human beings. Or destroy the very thing that makes us human. It's our choice.

A bit about me: I co-founded Flickr – and helped build companies like Etsy and Kickstarter from when they first started. I'm now a partner at Yes VC.

On today's show: Daniel Chao, the founder of Halo Neuroscience. His headset, that helps you learn like a kid again costs, a few hundred dollars. You want one? Easy. It's for sale online, and any adult can buy it.

When I first heard about Daniel's technology, I got extremely excited about the possibilities of becoming better and smarter, and mastering all of the languages and musical instruments I had ever wanted to learn. But then, I started to wonder, if everyone around me were using this device, would it just become a race to the top? Would all of us be on an endless success treadmill trying to outdo one another?

The first question I ask about any technology is: Who built it, and why?

CHAO: So let's go back to medical school.

FAKE: Palo Alto, California. Stanford. Daniel was sitting in pharmacology class, about to have an "aha" moment

CHAO: By week three or four, I realized that when people talk about the miracle of modern medicine, they're really talking about drugs: you take a little pill every day and it's as if you didn't have high blood pressure. Then you get to the chapter on drugs for the brain and the wheels fall off.

FAKE: We treat the brain with drugs, like the rest of the body. But the brain is different. Daniel started to focus in on that one solution that would make sense for treating the brain. And then he had a revelation.

CHAO: We know the brain is an electrical organ and we've known this for literally hundreds of years. And I was thinking like, "What if we spoke the brain's language? What if we used electricity to retune the brain circuits — potentially to treat disease, potentially to extract more performance out of otherwise healthy people?"

FAKE: Daniel sees himself in a long line of scientists who have pushed the boundaries of the brain using electricity, often in ways that sound truly bizarre.

CHAO: There's a scientist named Scribonius Largus who's a hero of ours here at the company. He used electric eels — literally electric eels. He'd get them agitated, to bite people. They used that as a way of curing what he called (literally 2,000 years ago) "melancholy" or what we call depression.

FAKE: In 2006, Daniel began working at NeuroPace. NeuroPace is a device that controls epilepsy with electric currents, or what's known as "neurostimulation". It won FDA approval and the vast majority of patients had their seizures reduced by 50% or more. So why isn't electricity the go-to treatment for everyone with epilepsy? Daniel remembers the exact moment when he understood.

CHAO: I was having dinner with an old friend of mine who was an epileptic. The more I told them about the surgery — and the equipment that would be installed in the skull and into the brain — he basically just cut me short and said “I can’t do this. This is too much.”

FAKE: What Daniel saw was *fear*. For neurostimulation to catch on, he needed to create *hope*.

CHAO: Maybe this was this “aha moment” that my now co-founder and I had. We began thinking about ways where we can build neurostimulators that were not a surgical implant. Potentially, neurostimulators that could be wearable.

The problem that we're trying to solve is, in a nutshell, the slowness of adult learning. Nobody has really ever asked this question, “Is this a solvable problem?” Our kids feel this virtuous cycle of putting in the effort where they just take off, and their body of knowledge grows. Where adults are the total opposite end of the spectrum: We try, try, try and we don't get enough, and then we just quit.

With neurostimulation, could we tilt this balance such that people move from the death spiral to this virtuous cycle?

FAKE: Before we go further, let me *show* you how this technology actually works.

Halo Sport looks like a simple black headset that a DJ would wear in a booth at the club, but it's not. The band of the headset is lined with electrodes, which look like short plastic spikes.

The spikes send electric pulses into the top of your head. This spot at the top of your head is the part of the brain that controls motion — the motor cortex. When you learned to ride a bicycle, it was the motor cortex that learned it. When you say you have “muscle memory,” it's the motor cortex that actually remembers.

When we learn new skills, our brain forms new connections, or neural pathways. This ability of our brain is called neuroplasticity. As we get older, our brains become less plastic. New connections still form, but more slowly. The electric pulses from the Halo headset supercharge your brain's natural plasticity and help you learn movements faster.

So what might Halo help you learn? The best example I've heard came from Baratunde Thurston, one of our Season One experts. Baratunde's favorite use case: Wedding dance videos.

BARATUNDE THURSTON: The first thing it really brought up for me was dancing. I did a lot of musicals in high school, and into college, and I was a pretty quick study, but I could be a quicker study with this. And the idea of being able to remember movements more easily, or more quickly, or in some way felt really cool.

I know it's been popular in recent years for people getting married to want to do a complex dance number at their weddings, and I just love the idea of wedding parties using Halo to up their skills to make their like dope wedding videos. That's just ridiculous, and fun, and makes for better YouTube experiences for the rest of us.

FAKE: Let's hear what Daniel thinks about this not-so-obvious use case.

FAKE: Okay, so do you think that this can help people making dope wedding videos?

CHAO: Yes, 100%. And I haven't even thought of how dope they can actually be, but no, I think it'd be a great use case because where Halo sport really shines is in repetitive moment. Like dancing's a great application because it's like "No, that's wrong, do it again with your hand in this position." Do it again, do it again, until you get it right. We've had a couple folks on Dancing with the Stars use this.

FAKE: No.

CHAO: Yeah. So why not recently-engaged people practicing for their wedding dance?

FAKE: Baratunde will return later in the show, to help us forecast different futures involving Halo. And there are a lot of possible futures. I really think there's a utopia built into Daniel's technology – and that utopia is a world in which everyone is learning. Everybody is flourishing. But I also think there's the potential that Daniel's technology could lead us to a dystopia — to a place where some people are more "equal" than others; a world of "Gattaca," where there are "special" people – and then the rest of us.

I couldn't wait to dig into these possibilities with Daniel.

FAKE: Competitive sports is one thing but I'm super interested in musical instruments and language acquisition. When I see Halo, the *halo* around it is around that kind of learning. Would you mind talking a little bit more about those use cases?

CHAO: We think of athletes as broader than just traditional sports, we think of musicians as athletes. Like a pianist or violinist — those are athletes too, in our opinion.

I used to play violin as a kid, and I'd love to pick up violin and try to play Beethoven's Concerto in D. It'd be a dream. But I'm looking at that and I'm thinking, "Wow, that's going to take forever and it's just not worth my time." So here's a life dream of mine that's pretty much lost – and that just sucks to me.

FAKE: I'm trying to wrap my simple, unzapped brain around how this technology plays out. You have to understand: I grew up as an overachiever, and when I was talking to Daniel, I immediately remembered this amazing video I saw on YouTube.

Let me describe it to you here. It's a mashup of the winning dismounts from the uneven bars in the 1952 Olympics, versus the winning dismount from today. The woman who won the gymnastics competition in 1952 dismounts and lands on her feet, she throws up her arms in triumph, and wins the gold medal. And then, in the Olympics from a few years ago, another woman dismounts, twists herself into five pretzels while in the air, then lands on her feet. She throws her arms up in triumph, and wins the gold medal.

This video just perfectly depicts the crazy acceleration we've seen in how good we have to be to win — not just in gymnastics but in everything.

FAKE: How do you feel about this vis-à-vis Halo? Are we over-optimizing the well-optimized?

CHAO: Let's just say for fun this technology becomes ubiquitous, and everybody starts using this. Or let's say not everybody, maybe only those with means have access to a technology like this, and there becomes this arms race.

Yeah, this is a world that I thought of, and I think this is going to happen with or without neurostimulation. The key weapon that I see today in this arms race is Adderall.

FAKE: Do you think that there's a possibility of abuse, like abusing it the same way that people are abusing Adderall?

CHAO: Abuse would be, maybe using it too much, too frequently. Or maybe you want to use it at a higher level of intensity. We thought of those things and we have both software and hardware checks in place.

FAKE: Competition being what it is, it's not usable with children – or is it?

CHAO: We do not recommend anyone under 18 to use it. Any adult who buys it for their kids, that's on them.

FAKE: I totally agree with Daniel's philosophy on kids. But I also couldn't help but wonder: Could neurostimulation be used safely in schools?

FAKE: It's the thing that people have been trying to build into education for a really long time, which is that you enjoy learning, you learn quickly, technology somehow helps you learn. And in this case, the ability, it actually does help you learn. But it doesn't have addictive properties.

CHAO: Video games are addictive because it spritzes in, intermittently, little blips of reward. And that's like a little drip of dopamine for your brain and you love it. Learning a

foreign language or math or anything in school, it's similar in that if you work hard, you'll make these little breakthroughs. And this is this little reward that your brain feels.

What if neurostimulation could accelerate learning, so that the drips of dopamine happen more predictably, more frequently. Wouldn't that be awesome? We see ourselves as the fertilizer that will help the seed grow faster. But you still have to plant the seed. And in the education model, you've got to plant the right seeds in the right part of the plot, otherwise it's not going to grow.

FAKE: If you are a parent, a student, or an educator: We'd love to know what you think about Halo being used in a school setting. Tweet at us using #ShouldThisExist.

FAKE: Is there something preventing Halo as a company from releasing Halo Language, Halo Music. You started with Halo Sport, what's the obstacle?

CHAO: It's just time and resources. We're building different form factors that target the electrode to different parts of the brain for different learning problems. The learning problem could be language and in that case, it wouldn't look like a set of headphones anymore because it would really awkward trying to target the language cortex because the language cortex is not conveniently right above our ears.

FAKE: So what else could we get Halo to help us learn? Can it help you be more compassionate? Could it help you be more patient?

CHAO: One could argue that compassion is a learned skill. I think we are born naturally with different amounts of compassion. Like anyone that's in a field that requires lots of compassion is probably born with a healthy dose of it, just naturally. And then there are others who are more cut throat, who are born with less of it. I would like to be more compassionate and I believe that neurostimulation can play a role there.

I should say that nothing happens in a vacuum, like the neurostimulation itself doesn't do anything unless the individual puts some training in. The same thing goes with training the brain to be more compassionate. If you don't practice it, then nothing happens.

FAKE: Any time you're trying to change human behavior, you have to think about the long game. I asked Daniel about what I thought might be his secret plan...

FAKE: When we were starting Flickr, it was 2003 and all of the hard work of getting people accustomed to the idea of putting their information online had been done by this company, Friendster. There was readiness for the technology.

You said that one of the reasons that you had started Halo is because your experience with NeuroPace showed you that in spite of its amazing efficacy, people were still

reluctant to do it. Do you see this as being the thin edge of the wedge? Is Halo a sneak readiness product?

CHAO: Is Halo the vehicle to get people used to neurostimulation, unafraid of neurostimulation, trying neurostimulation? Then, in the future, could we use that knowledge and comfort with neurostimulation to do implants?

Honestly, I haven't really even thought that far.

One of the limitations of our technology — and that's a double-edged sword, as it's probably the reason why it's so safe — is the level of penetration. It's very limited. The electric field can only go so deep into our brain before the strength of the field starts to fizzle out and it's not effective anymore.

Now, does Halo eventually evolve into a company that really hungers to solve some of these problems that involve deeper structures and does that involve a medical implant at that time or surgical implant of some sort? Maybe.

FAKE: I loved talking to Daniel, and could have talked to him forever. But the whole point of this show is to create a new kind of conversation – a conversation between the entrepreneur and the world.

When you're the inventor, it's easy to get stuck in your head and assume that your vision of a future is the only future that will exist. But spoiler alert: it's not.

So welcome to the Should This Exist? workshop. Here, Daniel and I will respond to ideas I've gathered from super smart, creative experts. We asked each of them to throw unexpected things at us, both possibilities and pitfalls that Daniel might otherwise miss.

The two experts I spoke with could not be more different. Kevin Delaney is a veteran journalist who has covered technology for over 20 years. He's the founder and editor in chief of Quartz. And he brings to us both his journalistic rigor – and his healthy skepticism.

KEVIN DELANEY: Halo is a really, really interesting idea, and it highlights more than anything how little we know about how our brain works.

FAKE: Baratunde is an Emmy-award nominated comedian, writer, and cultural critic who helped re-launch "The Daily Show with Trevor Noah". As you'll soon hear, Baratunde is always thinking about the unexpected ways technology sneaks into our social lives.

THURSTON: I wonder, if you get really good at the Halo, and you're amping up all the time, and you're using it to type better, to swipe better, to Tinder harder, to day-trade

better, whatever the physical motion is that's required, could you get so good at it that you basically become Professor X. It gets real weird. Now you're basically an X-Men.

FAKE: Kevin, thought Halo might become a crutch, with people depending on it to function in their everyday lives.

DELANEY: If I need my hyper learning headphones to be able to feel like I'm capable of learning anything, what do I do when I don't have my headphones? What I do if they're out of battery? What if I lack of confidence about my ability to learn that's not in some sort of artificially-assisted state?

FAKE: We can already learn without Halo. What happens when we feel dependent on the headset. Is Kevin right? Will Halo become a learning crutch? Here's Daniel's thought.

CHAO: Yeah, I guess it's definitely a risk. But I guess Halo sport wouldn't be the only product to run into this problem in the history of humanity. I get a little irritated if I'm not close to coffee in the morning. And I don't like it if I'm too far away from my cell phone. So there are these dependencies that I have with certain things. It's a tricky one. And I don't know if there's a solution, honestly, Caterina.

FAKE: Dependencies are one thing. But addiction is another. Could users become addicted to Halo? I pushed Daniel on this.

CHAO: We've never heard, in our thousands of users, that it was addictive in any way. Which, going into this, I could've predicted that. What makes something addictive is rapid on, rapid off. The feeling of something that comes rapidly on. Take for example, cocaine, one of the most addictive substances on Earth. And then rapid off. Like minutes later you feel the consequences of not having enough of it. With neurostimulation, especially our form of neurostimulation, the kinetics are not like that. It's slow on, slow off.

FAKE: Beyond the physical impact of neurostimulation on our bodies, Halo inspired Baratunde to ponder whether Halo could change the very nature of humanity.

THURSTON: Pumping your brain full of electricity instead of pumping your blood full of steroids or other physical enhancers? It feels like a real parallel act. I'm amped. I'm powered up, I'm lit. Right? Slang becomes literal with this device. I suspect, and I think on the other side of how people might use this and how popular it might get, is a yearning for a sort of artisanal, physical human.

FAKE: An artisanal human. I loved this idea that Halo could ultimately make us nostalgic for the time before neurostimulation.

THURSTON: There will be major debates about what qualifies as a “real human” in the future. In the same way you have to answer questions when you want to become a citizen of a nation, or get a job, or any kind of, anything you have to qualify for, you'll have to answer truthfully, “Have you taken any neuro-enhancing substances? Have you used any neuro-priming technologies in the past six months? Do you wear shoes?” Like what's the threshold?

When you watch people run marathons today, they're all wearing shoes, right? Shoes are like a technology that we didn't always have. But if you're going to run a marathon, you're definitely going to do it with shoes. You're probably going to do it with some kind of high performance shoe. You might even have compression clothing gear on.

FAKE: I gathered Daniel's thoughts about the idea of artisanal people vs. primed people.

CHAO: Right. What is a real human? I guess what is the Wikipedia definition of a real human? Or there's maybe a more philosophical angle like, "Are we all enhanced in some ways such that we're all not real? Is the humankind of the Paleolithic era ... a lot of people want to live like “cavemen.”

FAKE: The Paleo diet. We're kind of going that direction.

CHAO: Yeah, the Paleo diet. In only doing things like that, is that a real human? Live in caves and eat raw food and so-called whole foods. What's cheating, I guess? What is it that makes us unfair to the Paleolithic era?

FAKE: It's a great point. Our idea of a “real human” changes over time, to include technologies we can no longer live without. Let's get back to the tangible now. The hardware. The actual headset. Kevin wondered whether Halo *actually* works.

DELANEY: I think, at a base level, all of the research and marketing suggest that there is a placebo effect here. I know when I go out running, often before I go running, I drink a big cup of coffee. So 20 minutes into my run, when I'm starting to flag, I get this caffeine rush, which helps me get through my run. I think this is pretty similar, is my guess.

FAKE: So, how does Daniel account for the placebo effect in his research and testing, and how does he prove that yes, Halo actually works? I explored this with him.

CHAO: It's actually really important that we talk about the placebo effect. Thankfully, experimentally, there's a way to control for that. What you do is you take a group of people in a random way, split them into two. Half of them get real neurostimulation, and the other half get what we call “sham neurostimulation”.

So “sham neurostimulation” feels like the real thing, but it actually doesn't work. Just about everybody enrolled in the study feels like they're getting the real thing while only half of them are. They know they enrolled in a neurostimulation research trial and, “Heck, they're giving me this new task.” So they're very motivated because of that. There's your placebo effect, and we can see the rate at which they learn versus the experimental group, which is getting the real neurostimulation.

The hypothesis is that there would be a difference between the two groups. That the group getting real neurostimulation, their performance eventually will exceed the performance of the control group.

FAKE: Daniel proved his hypothesis. In one research trial measuring the impact of neurostimulation on people's ability perform complex piano chords. Those who received real neurostimulation improved by 32%, whereas those who did not improved by 18%.

I wanted to wrap up the session with some blue-sky utopian thinking – and some dark-cloud dystopian thinking. Our dystopian vision came, unexpectedly, from Baratunde.

FAKE: Who do you think would love this most?

THURSTON: Sadly, I think bosses will love this. And I'll be honest with you, like the darkest thought I had – because I've been living in a historical mode right now – was slavery, and forced labor, and sweatshops. And for those who can exercise power over the use of other people's bodies, they will want this. And in certain jurisdictions, they will be able to impose this on the workforce.

That is one of the darkest uses of this I could imagine, and we've been doing it for as long as there've been people: “Here is a hoe to help you move the soil more easily.” “Here is this vehicle to help you haul these things.” I don't want this to go that way. I don't want our world to go that way, but it has continued to show that it can, and will go that way.

I just see a terrible manager forcing their labor employees, their physical labor employees, to put these headphones on to like learn the moves faster, to be more efficient, to get 10, 20, 30% quicker, less exhaustion, at physically fulfilling orders

FAKE: And let's wrap up with some utopian thinking, courtesy of Kevin.

DELANEY: I think if this technology worked, I think there are lots of scenarios where it could be used to help people. There are lots of scenarios with re-training of workers whose jobs are being eliminated. There are lots of people who haven't had access to training and education and therefore are excluded from parts of the economy.

FAKE: And now let's hear from Daniel. How does he see Halo impacting the future of work? Here's what he had to say.

CHAO: Our first and only product right now is this product for movement learning. There are certainly jobs that involve movement, machine operators and that type of thing where the skill of one's hands is important for the outcome. But let's face it, the workforce is not going towards more manual, skilled labor. It's going away from that. So movement learning, I think, will have relatively low impact in helping people find new work.

I think it's really about cognitive learning and people's ability to learn new cognitive skills, critical thinking skills. It would be a different product.

FAKE: Presumably when you're learning in school or people who have just not had the same advantages as others could catch up more quickly.

CHAO: That's right. So much happens when we're young because that's when we learn the fastest. I think what our product does is it makes your brain temporarily kid-like. It makes it so that it's spongier, and it can absorb information, for a window of time of course, not permanently. But you could take advantage of this window of time to kind of shove more information in and have it stick to a greater extent.

So yeah, if someone grew up in an environment where they didn't have all the privileges of the learning opportunities, and the best teachers, and the best life experiences, and into adulthood they were afforded these opportunities, there's an opportunity to use a technology like this to play catch up.

FAKE: I love that scenario. Okay. Thank you so much, Daniel.

FAKE: I'm a generalist, not an expert in neuroscience. So like you, I'm trying to figure out what my life, and my friends' and families', would be like with Halo.

I know that all of you listening are experts in something. Whether it's sports, or education, or parenting – or even neuroscience. What do you think about Halo? I'd love to know. Should students use it in school? Should athletes use it to train? Let's start a real dialogue about the possibilities – and the perils. And of course, answer the question: Should This Exist?

Let us know what you think of Halo. Tweet at us using the hashtag #ShouldThisExist. And here's a special treat. I asked Sammus, a rapper pursuing her PhD in Science and Technology, to break down the science behind Halo.

SAMMUS: It seems we're engineering faster learning brains
Just imagine what can happen, all the risks and all the gains

Halo is a new device
That spurs a hyperplastic state
Meaning when you use it
you can learn at a much faster rate

You wear it like it's headphones
While you're practicing a sport cuz
Halo then moves 'lectric current
through your motor cortex

Which controls the motion in ya body
So when you add some voltage to the party
Your dome's just getting started

It all revolves around the organ bobbin' round ya noggin'
It's always turned on – whether you're nodding off or jogging
all your neurons – that's the term reserved for your nerve cells –
They send electric signals when you learn skills

And when you're learning a skill
Like how to bat or to rap great
Your brain is forming new neural pathways
But sad-face it won't last forever; older learners lag, yes indeed
Only younger folks have active neuroplasticity

That's another phrase for the state when your brain learns
When you come of age then your brain firms
NO – It gets less plastic the pathways get slow
We need something drastic – Halo come to the rescue!

But what does Halo mean for the haves and the have-nothings?
Rich cats get brain-hacks with some rad-plug-ins
The other half won't get past the competition;
Another way the cards are stacked against them

On the other hand Halo offers hope for slow and older learners
to overturn the code of programs running on our servers
What if humans each had Halo sitting in our toolkits?
What a feat it is to teach an older dog some new tricks

It seems we're engineering faster learning brains
Just imagine what can happen – all the risks and all the gains.